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Blue currency!!!- The role of Seagrasses as Carbon sinks

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Abstract- Carbon, progress from birth to death and decomposition in animals, in some plants it get trapped for long time, even thousands of years. Seagrasses are the hidden treasure could be termed as "blue currency". This vegetated marine habitat are hot spots for biodiversity, provides important and valuable ecosystem services, including carbon sink but are experiencing a steep global decline. In addition to burying a fraction of their own production, seagrasses reduce flow, alter turbulence and attenuate wave action. Seagrass serves as its own unique habitat. The meadows provide canopy cover that shelters small organisms such as invertebrates and juvenile fish, including commercial fish species. But their values are still underestimated in many parts of the world including in India.

Keywords**:** *Climate Change, Seagrass, Carbon Sequestration, Ocean Acidification.*

I. INTRODUCTION

On the streets, schools, colleges, buses and all other means of public systems, holds the tags of global warming, climate change and slogans to conserve and plant trees. This, though the intention is positive, passes a negative thought to the students in particular, that terrestrial vegetation as the only source of carbon dioxide (CO2) reduction. Only in the recent time scientist came out with the role of oceans in carbon sink and storage and termed it as 'Blue carbon sink' (Duarte et al., 2008).

Trapping of organic carbon accumulated in forests is considered as an important method for mitigating climate change. Like terrestrial ecosystems, coastal ecosystems store large amounts of carbon, and there are only very few initiatives to protect these 'blue carbon' stores. Marine environment comprising of coral reefs, seagrasses, Mangrove, salt marshes and other ecosystems accounts for the mass storage of carbon in one form or another (Duarte et al., 2005). Whereas, when compared with the importance and media attention given for the protection and afforestation of terrestrial vegetation, the policy makers and climate specialists have neglected the coastal ecosystems. Though seagrasses and mangroves are equally acquainted with tropical rain forests in terms of biodiversity, carbon sink and other innumerable ecosystem functions, they are decelerating four times faster than the tropical rain forest, and these facts are lesser known or not known to the world as they are not visible to common eye-'submerged' or located in remote locations.

Seagrasses are marine flowering plants occur in shallow coastal and estuarine waters around the world, influencing the physico-chemical and biological environs of marine waters. Although seagrass meadows cover a relatively small portion of the ocean (approx 1%), with 66 species world wide (Short et al., 2007), these plants provide critical habitats for aquatic life, and play an important role in the coastal zone providing ecosystem goods

and services that are of high value compared with other marine and terrestrial habitats. And further, the presences of seagrasses are global unlike corals, mangroves or salt marshes, which have limited spatial distribution.
India is also blessed with seagrasses, with large meadow formation in Lakshadweep, Andaman and Nicobar islands, Gulf of Mannar and Palk Bay (Tamilnadu), sparse distribution at Chilka lake (Orissa), Sundarbans (W.Bengal), Ashtamudi Estuary (Kerala), Goa and Gulf of Kachchh (Gujarath), with 14 species (Kannan et al., 2009). Many animals including endangered sea cow (Dugong dugon) and sea turtle (Chelonia mydas) feeds on seagrasses.

II. CARBON DYNAMICS IN SEAGRASSES

Rising CO2, due to industrialization and fuel combustion, major factor for global warming also have sever impacts on marine environment. It educes ocean pH and causes wholesale shifts in seawater carbonate chemistry. Seagrasses play a major role in protecting our planet from the increasing buildup of carbon dioxide. Seagrass beds sequester large amounts of carbon within plants above and below sea-level as well as within soils. In comparison to terrestrial ecosystems, these ecosystems are continuously building carbon pools, providing for an ongoing and long-term removal of carbon dioxide from the atmosphere. Kennedy and Bjork (2009) pointed out that seagrasses are responsible for about 15% of total carbon storage in the ocean with long-term carbon burial of 83 g C m-2yr-1 and this translates to global storage rates of between 27 and 40 Tg C yr-1.

Seagrasses can act as carbon sink, sequestering carbon dioxide from the atmosphere. McKenzie and Unsworth (2009) estimated that seagrass meadows sequester between 0.012 to 1.33 metric tons of carbon per hectare per year (t C ha-1yr-1). The amount of CO2 that is sequestered by seagrasses differs greatly and depends on species, whether it is fast or slow growing, the local environment and the time of year. The carbon assimilation and storage capacity by seagrasses through roots rhizomes and leaves, and decomposition and storage in the below sediments, could trap the carbon emission for more than 4000 years and slows down global warming (Seagrass watch, 2009) . Through photosynthesis they fix carbon dioxide, and thus CO2 and water (H20) is converted into carbohydrates and oxygen (1), which is released into oceanic water uses by other living creatures. Seagrass photosynthesis always causes an increase in pH, as CO2 is withdrawn from the water column during the photosynthesis, so the protons associated with carbonic acid, there by it act as warriors of ocean acidification.
A simple equation of photosynthesis,

$$6CO_2+6H_2O \xrightarrow{light} C_6H_{12}0_6+60_2 \qquad (1)$$

III. OCEAN ACIDIFICATION

Ocean acidification is not a minor climate issue; it is the other CO2 dispute. The world's leading marine scientists are warning us that our current rates of carbon emissions are making our oceans more acidic. This is happening so fast that it poses a serious threat to biodiversity and marine life. If ignored, ocean acidification could destroy all our coral reefs within this century. It also has the potential to disrupt other ocean ecosystems, fisheries, habitats, and even entire oceanic food chains.

Ocean acidification is the name given to the ongoing decrease in the pH of the oceans, caused by the increasing anthropogenic carbon dioxide. About a quarter of the carbon dioxide in the atmosphere goes into the oceans, where it forms carbonic acid. Ocean acidification, which like global climate change is driven by disproportionate levels of carbon dioxide, has been regarded by climate scientists as the "equally evil twin" of global climate change.

Between 1751 and 1994 surface ocean pH is estimated to have decreased from approximately 8.25 to 8.14 representing an increase of almost 30 % in "acidity" (H+ ion concentration) in the world's oceans.

A simple representation, how C02 is responsible for ocean acidification (Modified from Seagrass watch magazine; McKenzie & Unsworth (2009))

CO_2 when dissolves in water forms carbonic acid

$$C02+H20 \longrightarrow H2CO3 \quad (2)$$

This carbonic acid dissociates in the water releasing hydrogen ions and bicarbonate

$$H2CO3 \longrightarrow H++HCO3- \quad (3)$$

This increase in hydrogen ion (H^+) concentration causes an increase in acidity, and terms it as ocean acidification. And even it affects worse, as when these hydrogen ions combine with carbonate ions in the seawater to form bicarbonate,

$$H^+ + CO_3^{2-} \longrightarrow HCO_3 \quad (4)$$

This removes carbonate ions from the water, making it more difficult for organisms to form the CaCO3 they need for their shells or skelton.

II. INDIAN SCENARIO

Though, the society is well informed with the benefits and importance and conservation of the rainforests, there is a comparative lack of awareness on the status and benefits of vegetated coastal habitats, particularly seagrasses. As wrote by many marine scientists, this might be because of a “charisma” gap, where these often submerged, out of sight habitats, are not as appealing to the public as their terrestrial counterparts. Yet, because of their similar functions and threats, coastal habitats can be considered as blue carbon sinks. Most of the island ecosystems of India are expected to respond severely to the climate change, which would lead to drastic changes in diversity and existence. Whereas, seagrass ecosystem is reported to reduce the impact of climate change (Nobi *et al*., 2014).

As it extremely necessary to give more importance to restoration programmes of these degraded ecosystems, community and society should also keep an eye on the destruction of these valuable ecosystems, naturally or by anthropogenic factors, as it can cause severe impact. Seagrasses sequester and store large quantities of carbon in both the plants and in the sediment below them. If destroyed, degraded or lost this coastal ecosystem become sources of carbon dioxide emitted into the ocean and atmosphere. The emission of years old (more than 4000 years) carbon into the marine system due to the removal of seagrass ecosystem cause an unbalance in other ecosystem too. These release will also have global significance as the carbon storage by seagrass ecosystem is large compared to their area. The said loss of globally significant carbon pool “our blue currency” is additional to the other recognised critical ecosystem service provided by seagrasses. The accelerating destruction of the seagrasses around the world due to varied activities not only affect the carbon storage, it decelerates even the economic growth of the nation, and Indian scenario is also not different, as much valued fishery resources from the Indian mainland and Island regions depends on coastal ecosystem sustainability.

There is an urgent need for active, effective and practical measures to protect the vulnerable carbon pool stored in seagrasses, and the time has already passed to restore and re-establish, seagrasses carbon sequestration capacity. At least we can act now to stabilize our currency “our blue currency”.

III. CONCLUSION

Seagrass meadows though cover a relatively small portion of the ocean, play an important role in the coastal zone and provide high end ecosystem goods and services. Seagrasses is reported to reduce the impact of ocean acidification and act as an important carbon sequester in the marine environment. Considering this, these hidden treasures could be termed as “blue currency”. But in India and around the world they are threatened by human impacts related to coastal development and increased pressures from artisanal fisheries. India should take a

lead in developing protection and management measures for the coastal ecosystems. There should be a national plan for seagrass conservation and restoration as par with mangrove and coral conservation.

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